PATENT ABSTRACTS OF JAPAN

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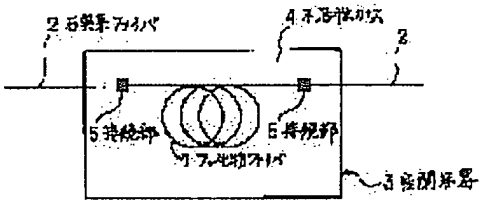
(54) OPTICAL AMPLIFIER

(57)Abstract:
PURPOSE: To avoid a discontinuity due to an increase in loss caused by absorption of OH group with respect to moisture of an optical fiber and deliquescence by introducing the fiber, whose core or a clad has as a basic material fluoride glass to which is added a rare earth element having a laser transition level, into a sealed vessel.
CONSTITUTION: A fluoride optical fiber 1 is introduced into a sealed vessel 3 filled with inert gas 4 for shielding from the atmosphere. A light is input to and output from the fiber 1 through a quartz series optical fiber 2, and externally output from a hole provided at the vessel 3. After the fiber 2 is passed through the hole of the vessel 3, it is buried with solder or adhesive having high airtightness. The fiber 1 of ZrF4 series without adding Pr is used. A connector 5 of the fiber 2 to the fiber 1 is connected by holding the fibers in a glass housing and so self-aligning them as to bring optical axes of the fibers into coincidence, and then connected by using UV adhesive.



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CLAIMS

[Claim(s)]
[Claim 1] The optical amplifier characterized by to put the optical fiber which added said rare earth elements at least into a well-closed container in the optical amplifier which has the magnification medium which uses as a laser active medium the optical fiber which added the rare earth elements which have laser transition level in the core section or the clad section, the excitation light source which generates the excitation light for exciting said laser active medium, the optic which combines said excitation light and an amplified light and is led to said laser active medium, and an optical isolator.
[Claim 2] The optical amplifier according to claim 1 characterized by the optical fiber which added said rare earth elements being an optical fiber which uses fluoride glass as basic material.
[Claim 3] The optical amplifier according to claim 1 or 2 characterized by being filled with inert gas in said well-closed container.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the optical FAIBA amplifier which aimed at the improvement in the dependability of the optical amplifier (henceforth an optical FAIBA optical amplifier) using optical needed FAIBA, and improvement in the yield at the time of production in the field of optical communication and optical measurement.
[0002]
[Description of the Prior Art] The optical fiber which added the rare earth elements which have laser transition level in the core section or the clad section attracts attention as an optical fiber for optical fiber amplifiers. With 1.5 micrometer band of signal wave length, the optical fiber amplifier which is excellent in efficient, high power power, a polarization-independent property, a low noise, etc. is realized by adding Er element on a quartz system fiber. On the other hand, with 1.3 micrometer band of signal wave length, the fluoride fiber which added Pr is proposed, current and this optical fiber amplifier are turned to implementation, and it inquires briskly.
[0003] The basic configuration (conventional technique) of 1.3-micrometer band optical fiber amplifier is shown in drawing 5 . In drawing 5 , 1 is Pr addition fluoride fiber and the optical fiber of 2% or more of high relative index difference deltan is used for relative index difference deltan for raising a gain coefficient. An optical fiber coupler for the excitation light source (for excitation wavelength to be 1.02 micrometers) to which 6 excites Pr addition fluoride optical fiber 1, and 7 to multiplex the excitation light and signal light which were generated in the excitation light source 6, and 8 are the fiber mold optical isolators for suppressing the oscillation of an optical amplifier. The optical fiber used with an optical fiber coupler 7 and the fiber mold optical isolator 8 is a silica glass fiber respectively, and relative index difference deltan is usually 0.3%. 9 is the TEC-silica glass fiber to which the end had the core expanded by the TEC

(Thermally Dihused-Expanded-Core = expansion by thermal diffusion) technique. It has relative index difference deltan almost equivalent to Pr addition fluoride fiber 1, and cut-off wavelength. It inserts between an optical fiber coupler 7, Pr addition fluoride fiber 1, and the fiber mold optical isolator 8 and Pr addition fluoride fiber 1. It is used in order to raise the joint effectiveness of an optical fiber coupler 7, Pr addition fluoride optical fiber 1, and the fiber mold optical isolator 8 and Pr addition fluoride optical fiber 1. 5 is the connection of Pr addition fluoride optical fiber 1 and the TEC-silica glass fiber 9. The connection 5 of a silica glass fiber 2 and the fluoride optical fiber 1 holds each fiber to a glass case, and it connects it after alignment using adhesives so that the optical axis of optical fibers may be in agreement.
[0004]
[Problem(s) to be Solved by the Invention] However, with the configuration of the conventional optical fiber amplifier, a problem is in the dependability of Pr addition fluoride optical fiber 1.
[0005]
[Table 1]

[0006] The chemistry weatherability and the mechanical strength of a fluoride optical fiber are shown in Table 1 (each value of silica optical fiber is doubled and shown in this table 1 for a comparison). However, a chemical weatherability value shows the underwater solubility per unit day unit area of fluoride glass, and this value shows that a fluoride optical fiber is very weak to moisture. Although the coat of the polymers, such as current Teflon or ultraviolet-rays hardening resin (UV resin is called hereafter), is carried out on the surface of the fiber in order to reduce these problems, it has come to solve this problem.
[0007] Drawing 6 shows one example of aging of loss [in / for a fluoride optical fiber (ZrF4 system, the rate of specific refraction of 0.3%, cut-off wavelength of 1.1 micrometers) / the magnification wavelength of 1.3 micrometers in the condition of the temperature of 20 degrees C, and 98% of humidity]. The protective coat (thickness of 5 micrometers) of Teflon was given, and the fluoride optical fiber was rolled and measured in diameter of 100mm. However, Pr is not added by the fluoride optical fiber. With time amount, the loss value was disconnected in about 4.2 for the deliquescence of a fiber while it increased for absorption of an OH radical.
[0008] Moreover, since the mechanical strength is low, it has troubles, such as breakage at the time of activity, for an optical amplifier, and the yield of a product is reduced. moreover, current [Pr] -- except for a fluoride optical fiber -- chloride glass fiber, bromide glass fiber, fluoride-chloride glass fiber, and bromination -- it added on - iodide glass fiber or a chalcogenide glass fiber, and although improving a magnification property was examined, in said presentation, there were all the same problems as a fluoride fiber.
[0009] Moreover, there is a problem also in the dependability of a connection 5 with time with the conventional technique shown in drawing 5 . That is, since adhesives were used for a

connection, the adhesion property deteriorated in four - five years, and there was a problem of resulting in an open circuit.
[0010] This invention is made in order to **** said trouble, and the purpose of this invention is to offer the technique which can be improved in the dependability over the moisture of the non-silica glass fiber which added required Pr addition, when it constitutes the optical fiber amplifier in magnification wavelength the band of 1.3 micrometers.
[0011] Other purposes of this invention reduce breakage of the optical fiber at the time of an optical amplifier configuration, and are to offer the technique which can be improved in the workability of amplifier activity while they avoid reduction of the increment in loss resulting from the OH radical absorption in magnification wavelength the band of 1.3 micrometers, and the open circuit accompanying deliquescence.
[0012] Other purposes of this invention are in the optical fiber amplifier which used quartz glass fiber as an optical amplification medium to offer the technique which can avoid degradation of a connection.
[0013] Other purposes and new descriptions are clarified by description and the accompanying drawing of this specification at said row of this invention.
[0014]
[Means for Solving the Problem] The magnification medium by which this invention uses as a laser active medium the optical fiber which added the rare earth elements which have laser transition level in the core section or the clad section in order to attain said purpose, In the optical fiber amplifier which has the excitation light source which generates the excitation light for exciting said laser active medium, the optic which combines said excitation light and an amplified light and is led to said laser active medium, and an optical isolator It is characterized [main] by putting the optical fiber which added said rare earth elements at least into a well-closed container.
[0015] The optical fiber which added said rare earth elements is characterized by being the optical fiber which uses fluoride glass as basic material.
[0016] It is characterized by being filled with inert gas in said well-closed container.
[0017]
[Function] According to the means mentioned above, the open circuit accompanying the increment in loss and the deliquescence which install an optical fiber into a well-closed container, and originate in the OH radical absorption in magnification wavelength the band of 1.3 micrometers to the moisture of an optical fiber since I/O of light is performed through the silica glass fiber which is excellent in dependability and reinforcement can be avoided, and breakage of the optical fiber at the time of an optical fiber amplifier configuration can be reduced, and the workability of optical fiber amplifier activity can be improved. Moreover, degradation of a connection is avoidable with said configuration.
[0018]
[Example] Below, with reference to a drawing, the example of this invention is explained at a detail.
(Example 1) Drawing 1 is a ** type block diagram for explaining the outline configuration of the example 1 of the optical fiber amplifier of this invention. For a fluoride optical fiber and 2, as for a well-closed container and 4, in drawing 1 , a silica glass fiber and 3 are [1 / inert gas and 5] the connections of a non-silica glass fiber and a silica glass fiber 2. Since the fluoride optical fiber 1 intercepts with the open air, it is put in by it into the well-closed container 3 filled with inert gas 4. I/O of the light to the fluoride optical fiber 1 is performed through a silica glass fiber

2. A silica glass fiber 2 is taken out from the hole established in the well-closed container 3 outside. However, after the hole of a well-closed container 3 lets a silica glass fiber 2 pass, it is fill uped with solder or airtight high adhesives.
[0019] Said fluoride optical fiber 1 is a fluoride fiber of ZrF4 system, and is 1.1 micrometers in 0.3% of rates of specific refraction, and cut-off wavelength. That by which Pr is not added is used for the fluoride optical fiber 1. Moreover, the protective coat (thickness of 5 micrometers) of Teflon is given, and this fluoride optical fiber 1 is wound around the diameter of 100mm.
[0020] A silica glass fiber 2 is a silica glass fiber by which the metal coat was carried out, and is 1.2 micrometers in deltan0.3% of rates of specific refraction, and cut-off wavelength. Producing a well-closed container 3 using stainless steel, size is 120x120x10mm. Moreover, it was full of dry nitrogen as inert gas. The silica glass fiber 2 is taken out from the hole established in the well-closed container.
[0021] However, after the hole for said silica-glass-fiber 2 lets a silica glass fiber 2 pass, it is fill uped with the airtight high adhesives used for a vacuum housing.
[0022] A connection 5 shows the connection of the quartz system fiber 2 and the fluoride fiber 1, holds each fiber to a glass case, and it is connected after alignment using UV adhesives so that the optical axis of optical fibers may be in agreement.
[0023] Drawing 2 shows aging of the loss in the magnification wavelength of 1.3 micrometers in the condition of the temperature of 20 degrees C of fluoride light FASHIBA 2 into which it is the property Fig. showing aging of loss of the fluoride optical fiber 2 of this example 1, and was put into the well-closed container, and 98% of humidity. Moreover, the result of having carried out same measurement is doubled and shown in drawing 2 in the condition of not going into a well-closed container.
[0024] As shown in drawing 2 , the open circuit accompanying the increment and deliquescence of loss resulting from an OH radical was solvable by putting the fluoride optical fiber 1 into a well-closed container 3.
[0025] Moreover, it has also united and checked that the fluoride fiber 1 is transposed to silica optical fiber 2, the above-mentioned measurement is performed, and there is no degradation also in a quartz, and avoiding degradation of a connection 5.
[0026] (Example 2) Drawing 3 is the mimetic diagram explaining the outline configuration of the magnification characterization system of the example 2 of this invention of slack.
[0027] This example 2 constituted the optical fiber amplifier of the magnification wavelength the band of 1.3 micrometers which used this invention, as shown in drawing 3 . An optical fiber 1 is 1.1 micrometers in deltan3.7% of rates of specific refraction, and cut-off wavelength using the fluoride optical fiber of ZrF4 system which added 500 ppm of Pr.
[0028] Moreover, a Teflon protective coat (thickness of 5 micrometers) is given, and this optical fiber 1 is wound around the diameter of 100mm. The connection 5 of the quartz system fiber 2 and the fluoride fiber 1 holds each fiber to a glass case, and it is connected after alignment using UV adhesives so that the optical axis of optical fibers may be in agreement. Producing a well-closed container 3 using stainless steel, size is 120x120x10mm. Moreover, it was full of dry nitrogen as inert gas. The quartz system fiber 2 was taken out from the hole established in the well-closed container. However, after the hole for said quartz system fiber 2 lets a fiber pass, it is fill uped with the airtight high adhesives used for a vacuum housing 3.
[0029] A fiber mold optical isolator for an optical fiber coupler for the excitation light source (for excitation wavelength to be 1.02 micrometers) for 6 to excite Pr addition optical fiber 1 fluoride and 7 to multiplex the excitation light and signal light which were generated in the

excitation light source 6, and 8 to suppress the oscillation of an optical amplifier, and 9 are the TEC-silica glass fibers by which the metal coat was carried out, and are 0.7 micrometers in deltan2.3% of rates of specific refraction, and cut-off wavelength.

[0030] Drawing 4 is the property Fig. showing aging of the magnification property of this example 2, the excitation quantity of light is 150mW, and measurement wavelength is 1.3 micrometers. in drawing 4 , the result measured where Pr addition fluoride fiber 1 is dipped underwater (a well-closed container -- intact), and the result measured where a well-closed container 3 is used are doubled and shown. In [well-closed container] not using it, while the magnification property deteriorated by absorption of an OH radical, it disconnected in the 2nd day.

[0031] However, in the condition of having put in in the well-closed container 3, it is changeless in a magnification property and has checked that the reinforcement to moisture improved by using a well-closed container 3 also from this example 2. Moreover, since Pr addition fluoride fiber 1 was put into the well-closed container 3 and the optical amplifier was constituted, breakage of Pr addition fiber at the time of a configuration was not generated at all. This has also doubled and checked that a step stop of the configuration of optical fiber amplifier also improved.

[0032] Furthermore, in the inside of a well-closed container 3, even if it used inert gas, such as a vacua, or Ar, helium, the same effectiveness as the above was acquired.

[0033] Although the fluoride fiber and quartz fiber of ZrF4 system were used as an optical fiber in the above example Other fluoride fibers, for example, InF3 system, ZnF2 system, AlF3 system glass (Tetsuro Izumiya editorial supervision), etc. The new "glass and its physical-properties" chapter 16 management system lab issue, 1984, or -- Tomozawa and Doremus ** Treatiseon materials science and technology volum 26 and Chapter 4 Academic Press, Inc. 1985, etc. In addition to the fluoride optical fiber using the glass of reference, or fluoride glass, chloride glass, such as a ThC14-PbC12-NaCl system, The bromide glass of AgBr-PbBr2-CsBr-CdBr2 system, the fluoride-chloride glass of a CdF2-BaCl2-NaCl system, the bromination of a ZnBr2-TlBr-TlI system - iodation glass (a "new glass handbook" --), Refer to new glass handbook edit ********, Maruzen Co., Ltd., and 1991, Moreover, glass, such as a germanium-S system, an As-S system, a germanium-P-S system, and As-germanium-S system chalcogenide glass, and the optical fiber which consists of phosphoric acid glass, ****** glass, and aluminum-silicate glass may be used further.

[0034] Moreover, in said example, although the quality of the material of a well-closed container also used stainless steel, it may use other metals or airtight high resin. Furthermore, although the hole of a well-closed container was fill uped with airtight high adhesives after letting a fiber pass, you may bury with solder.

[0035] As mentioned above, although this invention was concretely explained based on the example, it cannot be overemphasized that it can change variously in the range which this invention is not limited to said example and does not deviate from the summary.

[0036]

[Effect of the Invention] As mentioned above, since according to this invention an optical fiber is installed into a well-closed container and I/O of light is performed through the silica glass fiber which is excellent in dependability and reinforcement as explained, the open circuit accompanying the increment in loss and deliquescence resulting from the OH radical absorption in magnification wavelength the band of 1.3 micrometers to the moisture of an optical fiber is avoidable.

[0037] Moreover, since an optical amplifier can be constituted where an optical fiber is put into a

well-closed container, breakage of the optical fiber at the time of the configuration of an optical fiber amplifier can be reduced, and the workability of the activity of an optical fiber amplifier can be improved.
[0038] Moreover, degradation of a connection is avoidable with said account configuration.
[0039] Therefore, the reliable optical fiber amplifier could be constituted from the above thing, and since improvement in a step stop at the time of production was aimed at further, the low price of an optical fiber amplifier became possible.

TECHNICAL FIELD

[Industrial Application] This invention relates to the optical FAIBA amplifier which aimed at the improvement in the dependability of the optical amplifier (henceforth an optical FAIBA optical amplifier) using optical needed FAIBA, and improvement in the yield at the time of production in the field of optical communication and optical measurement.

PRIOR ART

[Description of the Prior Art] The optical fiber which added the rare earth elements which have laser transition level in the core section or the clad section attracts attention as an optical fiber for optical fiber amplifiers. With 1.5 micrometer band of signal wave length, the optical fiber amplifier which is excellent in efficient, high power power, a polarization-independent property, a low noise, etc. is realized by adding Er element on a quartz system fiber. On the other hand, with 1.3 micrometer band of signal wave length, the fluoride fiber which added Pr is proposed, current and this optical fiber amplifier are turned to implementation, and it inquires briskly.
[0003] The basic configuration which is 1.3-micrometer band optical fiber amplifier at drawing 5

EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, since according to this invention an optical fiber is installed into a well-closed container and I/O of light is performed through the silica glass fiber which is excellent in dependability and reinforcement as explained, the open circuit accompanying the increment in loss and deliquescence resulting from the OH radical absorption in magnification wavelength the band of 1.3 micrometers to the moisture of an optical fiber is avoidable.
[0037] Moreover, since an optical amplifier can be constituted where an optical fiber is put into a well-closed container, breakage of the optical fiber at the time of the configuration of an optical fiber amplifier can be reduced, and the workability of the activity of an optical fiber amplifier can be improved.
[0038] Moreover, degradation of a connection is avoidable with said account configuration.
[0039] Therefore, the reliable optical fiber amplifier could be constituted from the above thing, and since improvement in a step stop at the time of production was aimed at further, the low price of an optical fiber amplifier became possible.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, with the configuration of the conventional optical fiber amplifier, a problem is in the dependability of Pr addition fluoride optical fiber 1.
[0005]
[Table 1]

〔表 1〕

		フッ化物ファイバ	石英ファイバ
(II) 化学的耐候性		2.1×10^{-2} g/cm²/day	0.1×10^{-8} g/cm² day以下
(III)機械的強度	(a)引張り強度	400MPa	6GPa
	(a)曲げ強度	500MPa	7GPa

[0006] The chemistry weatherability and the mechanical strength of a fluoride optical fiber are shown in Table 1 (each value of silica optical fiber is doubled and shown in this table 1 for a comparison). However, a chemical weatherability value shows the underwater solubility per unit day unit area of fluoride glass, and this value shows that a fluoride optical fiber is very weak to moisture. Although the coat of the polymers, such as current Teflon or ultraviolet-rays hardening resin (UV resin is called hereafter), is carried out on the surface of the fiber in order to reduce these problems, it has come to solve this problem.
[0007] Drawing 6 shows one example of aging of loss [in / for a fluoride optical fiber (ZrF4 system, the rate of specific refraction of 0.3%, cut-off wavelength of 1.1 micrometers) / the magnification wavelength of 1.3 micrometers in the condition of the temperature of 20 degrees C, and 98% of humidity]. The protective coat (thickness of 5 micrometers) of Teflon was given, and the fluoride optical fiber was rolled and measured in diameter of 100mm. However, Pr is not added by the fluoride optical fiber. With time amount, the loss value was disconnected in about 4.2 for the deliquescence of a fiber while it increased for absorption of an OH radical.
[0008] Moreover, since the mechanical strength is low, it has troubles, such as breakage at the time of activity, for an optical amplifier, and the yield of a product is reduced. moreover, current [Pr] -- except for a fluoride optical fiber -- chloride glass fiber, bromide glass fiber, fluoride-chloride glass fiber, and bromination -- it added on - iodide glass fiber or a chalcogenide glass fiber, and although improving a magnification property was examined, in said presentation, there were all the same problems as a fluoride fiber.
[0009] Moreover, there is a problem also in the dependability of a connection 5 with time with the conventional technique shown in drawing 5 . That is, since adhesives were used for a connection, the adhesion property deteriorated in four - five years, and there was a problem of resulting in an open circuit.
[0010] This invention is made in order to **** said trouble, and the purpose of this invention is to offer the technique which can be improved in the dependability over the moisture of the non-silica glass fiber which added required Pr addition, when it constitutes the optical fiber amplifier in magnification wavelength the band of 1.3 micrometers.
[0011] Other purposes of this invention reduce breakage of the optical fiber at the time of an optical amplifier configuration, and are to offer the technique which can be improved in the

workability of amplifier activity while they avoid reduction of the increment in loss resulting from the OH radical absorption in magnification wavelength the band of 1.3 micrometers, and the open circuit accompanying deliquescence.
[0012] Other purposes of this invention are in the optical fiber amplifier which used quartz glass fiber as an optical amplification medium to offer the technique which can avoid degradation of a connection.
[0013] Other purposes and new descriptions are clarified by description and the accompanying drawing of this specification at said row of this invention.

MEANS

[Means for Solving the Problem] The magnification medium by which this invention uses as a laser active medium the optical fiber which added the rare earth elements which have laser transition level in the core section or the clad section in order to attain said purpose, In the optical fiber amplifier which has the excitation light source which generates the excitation light for exciting said laser active medium, the optic which combines said excitation light and an amplified light and is led to said laser active medium, and an optical isolator It is characterized [main] by putting the optical fiber which added said rare earth elements at least into a well-closed container.
[0015] The optical fiber which added said rare earth elements is characterized by being the optical fiber which uses fluoride glass as basic material.
[0016] It is characterized by being filled with inert gas in said well-closed container.

OPERATION

[Function] According to the means mentioned above, the open circuit accompanying the increment in loss and the deliquescence which install an optical fiber into a well-closed container, and originate in the OH radical absorption in magnification wavelength the band of 1.3 micrometers to the moisture of an optical fiber since I/O of light is performed through the silica glass fiber which is excellent in dependability and reinforcement can be avoided, and breakage of the optical fiber at the time of an optical fiber amplifier configuration can be reduced, and the workability of optical fiber amplifier activity can be improved. Moreover, degradation of a connection is avoidable with said configuration.

EXAMPLE

[Example] Below, with reference to a drawing, the example of this invention is explained at a detail.
(Example 1) Drawing 1 is a ** type block diagram for explaining the outline configuration of the example 1 of the optical fiber amplifier of this invention. For a fluoride optical fiber and 2, as for a well-closed container and 4, in drawing 1 , a silica glass fiber and 3 are [1 / inert gas and 5] the connections of a non-silica glass fiber and a silica glass fiber 2. Since the fluoride optical fiber 1 intercepts with the open air, it is put in by it into the well-closed container 3 filled with inert gas 4. I/O of the light to the fluoride optical fiber 1 is performed through a silica glass fiber

2. A silica glass fiber 2 is taken out from the hole established in the well-closed container 3 outside. However, after the hole of a well-closed container 3 lets a silica glass fiber 2 pass, it is fill uped with solder or airtight high adhesives.
[0019] Said fluoride optical fiber 1 is a fluoride fiber of ZrF4 system, and is 1.1 micrometers in 0.3% of rates of specific refraction, and cut-off wavelength. That by which Pr is not added is used for the fluoride optical fiber 1. Moreover, the protective coat (thickness of 5 micrometers) of Teflon is given, and this fluoride optical fiber 1 is wound around the diameter of 100mm.
[0020] A silica glass fiber 2 is a silica glass fiber by which the metal coat was carried out, and is 1.2 micrometers in deltan0.3% of rates of specific refraction, and cut-off wavelength. Producing a well-closed container 3 using stainless steel, size is 120x120x10mm. Moreover, it was full of dry nitrogen as inert gas. The silica glass fiber 2 is taken out from the hole established in the well-closed container.
[0021] However, after the hole for said silica-glass-fiber 2 lets a silica glass fiber 2 pass, it is fill uped with the airtight high adhesives used for a vacuum housing.
[0022] A connection 5 shows the connection of the quartz system fiber 2 and the fluoride fiber 1, holds each fiber to a glass case, and it is connected after alignment using UV adhesives so that the optical axis of optical fibers may be in agreement.
[0023] Drawing 2 shows aging of the loss in the magnification wavelength of 1.3 micrometers in the condition of the temperature of 20 degrees C of fluoride light FASHIBA 2 into which it is the property Fig. showing aging of loss of the fluoride optical fiber 2 of this example 1, and was put into the well-closed container, and 98% of humidity. Moreover, the result of having carried out same measurement is doubled and shown in drawing 2 in the condition of not going into a well-closed container.
[0024] As shown in drawing 2 , the open circuit accompanying the increment and deliquescence of loss resulting from an OH radical was solvable by putting the fluoride optical fiber 1 into a well-closed container 3.
[0025] Moreover, it has also united and checked that the fluoride fiber 1 is transposed to silica optical fiber 2, the above-mentioned measurement is performed, and there is no degradation also in a quartz, and avoiding degradation of a connection 5.
[0026] (Example 2) Drawing 3 is the mimetic diagram explaining the outline configuration of the magnification characterization system of the example 2 of this invention of slack.
[0027] This example 2 constituted the optical fiber amplifier of the magnification wavelength the band of 1.3 micrometers which used this invention, as shown in drawing 3 . An optical fiber 1 is 1.1 micrometers in deltan3.7% of rates of specific refraction, and cut-off wavelength using the fluoride optical fiber of ZrF4 system which added 500 ppm of Pr.
[0028] Moreover, a Teflon protective coat (thickness of 5 micrometers) is given, and this optical fiber 1 is wound around the diameter of 100mm. The connection 5 of the quartz system fiber 2 and the fluoride fiber 1 holds each fiber to a glass case, and it is connected after alignment using UV adhesives so that the optical axis of optical fibers may be in agreement. Producing a well-closed container 3 using stainless steel, size is 120x120x10mm. Moreover, it was full of dry nitrogen as inert gas. The quartz system fiber 2 was taken out from the hole established in the well-closed container. However, after the hole for said quartz system fiber 2 lets a fiber pass, it is fill uped with the airtight high adhesives used for a vacuum housing 3.
[0029] A fiber mold optical isolator for an optical fiber coupler for the excitation light source (for excitation wavelength to be 1.02 micrometers) for 6 to excite Pr addition optical fiber 1 fluoride and 7 to multiplex the excitation light and signal light which were generated in the

excitation light source 6, and 8 to suppress the oscillation of an optical amplifier, and 9 are the TEC-silica glass fibers by which the metal coat was carried out, and are 0.7 micrometers in deltan2.3% of rates of specific refraction, and cut-off wavelength.
[0030] Drawing 4 is the property Fig. showing aging of the magnification property of this example 2, the excitation quantity of light is 150mW, and measurement wavelength is 1.3 micrometers. in drawing 4 , the result measured where Pr addition fluoride fiber 1 is dipped underwater (a well-closed container -- intact), and the result measured where a well-closed container 3 is used are doubled and shown. In [well-closed container] not using it, while the magnification property deteriorated by absorption of an OH radical, it disconnected in the 2nd day.
[0031] However, in the condition of having put in in the well-closed container 3, it is changeless in a magnification property and has checked that the reinforcement to moisture improved by using a well-closed container 3 also from this example 2. Moreover, since Pr addition fluoride fiber 1 was put into the well-closed container 3 and the optical amplifier was constituted, breakage of Pr addition fiber at the time of a configuration was not generated at all. This has also doubled and checked that a step stop of the configuration of optical fiber amplifier also improved.
[0032] Furthermore, in the inside of a well-closed container 3, even if it used inert gas, such as a vacua, or Ar, helium, the same effectiveness as the above was acquired.
[0033] Although the fluoride fiber and quartz fiber of ZrF4 system were used as an optical fiber in the above example Other fluoride fibers, for example, InF3 system, ZnF2 system, AlF3 system glass (Tetsuro Izumiya editorial supervision), etc. The new "glass and its physical-properties" chapter 16 management system lab issue, 1984, or -- Tomozawa and Doremus ** Treatiseon materials science and technology volum 26 and Chapter 4 Academic Press, Inc. 1985, etc. In addition to the fluoride optical fiber using the glass of reference, or fluoride glass, chloride glass, such as a ThC14-PbC12-NaCl system, The bromide glass of AgBr-PbBr2-CsBr-CdBr2 system, the fluoride-chloride glass of a CdF2-BaCl2-NaCl system, the bromination of a ZnBr2-TlBr-TlI system - iodation glass (a "new glass handbook" --), Refer to new glass handbook edit ********, Maruzen Co., Ltd., and 1991, Moreover, glass, such as a germanium-S system, an As-S system, a germanium-P-S system, and As-germanium-S system chalcogenide glass, and the optical fiber which consists of phosphoric acid glass, ****** glass, and aluminum-silicate glass may be used further.
[0034] Moreover, in said example, although the quality of the material of a well-closed container also used stainless steel, it may use other metals or airtight high resin. Furthermore, although the hole of a well-closed container was fill uped with airtight high adhesives after letting a fiber pass, you may bury with solder.
[0035] As mentioned above, although this invention was concretely explained based on the example, it cannot be overemphasized that it can change variously in the range which this invention is not limited to said example and does not deviate from the summary.

DESCRIPTION OF DRAWINGS

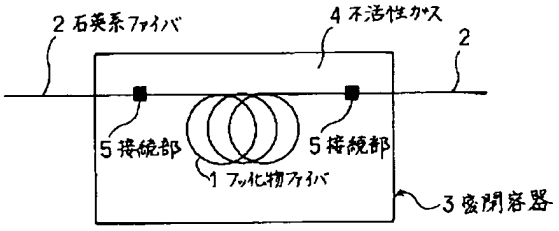
[Brief Description of the Drawings]
[Drawing 1] The ** type block diagram for explaining the outline configuration of the example 1 of the optical fiber amplifier of this invention,
[Drawing 2] The property Fig. showing aging of loss of the fluoride fiber of this example 1,

[Drawing 3] The ** type block diagram for explaining the outline configuration of the magnification characterization system of the example 2 of this invention,
[Drawing 4] Drawing 4 is the property Fig. showing aging of the magnification property of this example 2.
[Drawing 5] The ** type block diagram for explaining the conventional technique,
[Drawing 6] The property Fig. showing aging of loss of the fluoride fiber in the conventional technique.
[Description of Notations]
1 [-- Inert gas, 5 / -- The connection of a non-quartz system fiber and a quartz system fiber, 6 / -- The excitation light source (excitation wavelength is 1.02 micrometers), 7 / -- An optical fiber coupler, 8 / -- A fiber mold optical isolator 9 / -- TEC-silica glass fiber to which the end had the core expanded by TEC.] -- A fluoride optical fiber, 2 -- A silica glass fiber, 3 -- A well-closed container, 4

DRAWINGS

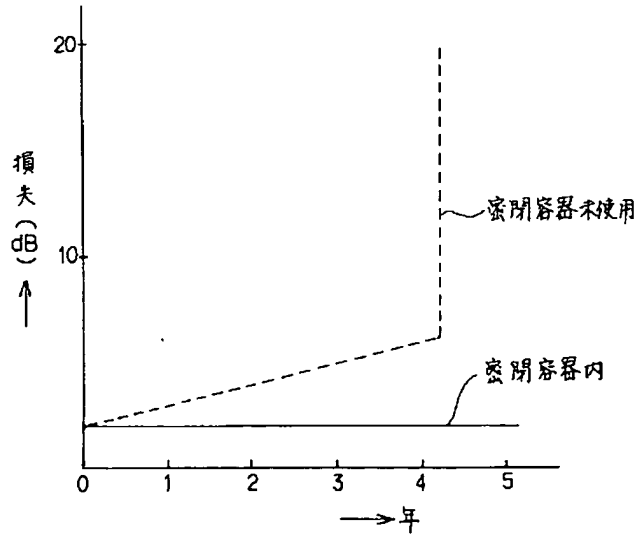
[Drawing 1]

図1



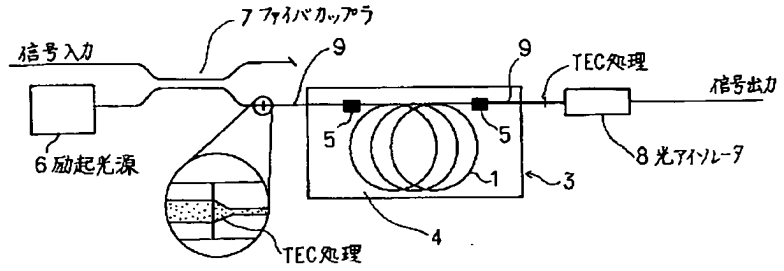
[Drawing 2]

図2



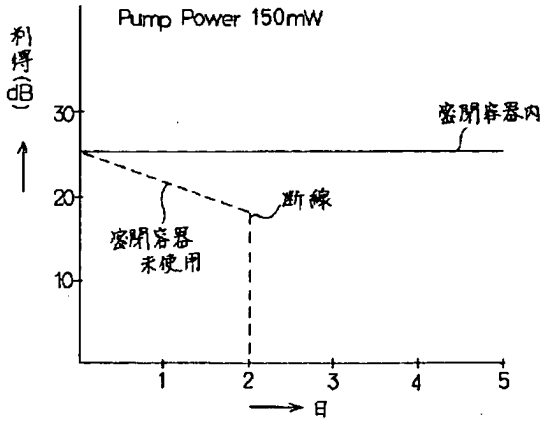
[Drawing 3]

図3



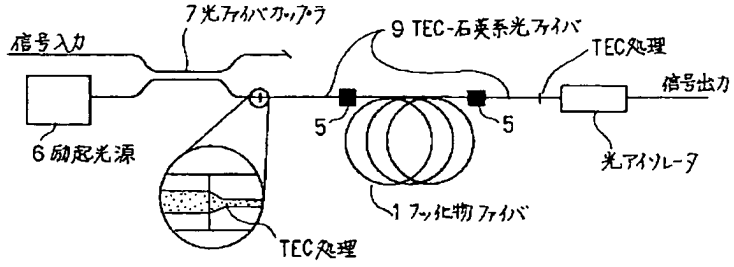
[Drawing 4]

図4



[Drawing 5]

図5



[Drawing 6]

図6